CLAIMS

1. A method of analysing results from an electromagnetic survey of an area that is thought or known to contain a subterranean resistive or conductive body, comprising:

providing electric field data and magnetic field data obtained by at least one receiver from at least one horizontal electric dipole (HED) transmitter;

determining a vertical gradient in the electric field data; and

combining the vertical gradient in the electric field data with the magnetic field data to generate combined response data.

2. A method of analysing results from an electromagnetic survey according to claim 1, wherein the electric field data include a horizontal component of electric field resolved along a first direction and the magnetic field data include a horizontal component of magnetic field data resolved along a second direction, the first and second directions being different.

3. A method of analysing results from an electromagnetic survey according to claim 2, wherein the first and second directions are orthogonal to one another.

4. A method of analysing results from an electromagnetic survey according to claim 2 or claim 3, wherein the first direction is parallel to a line connecting the HED transmitter to the receiver.

5. A method of analysing results from an electromagnetic survey according to claim 2 or claim 3, wherein the first direction is perpendicular to a line connecting the HED transmitter to the receiver.

6. A method of analysing results from an electromagnetic survey according to any of claims 1 to 5, wherein the vertical gradient in the electric field data is determined by comparing electric field data detected at different heights.

7. A method of analysing results from an electromagnetic survey according to any of claims 1 to 5, wherein the vertical gradient in the electric field data is determined by comparing the electric field data and data simulated using a background model.

8. A method of analysing results from an electromagnetic survey according to claim 7, wherein the data simulated using a background model provide a boundary condition for the electric field data.

9. A method of analysing results from an electromagnetic survey according to any of claims 1 to 5, wherein the vertical gradient in the electric field data at a first receiver is determined by comparing electric field data from the first receiver when the transmitter is above a second receiver with electric field data from the second receiver when the transmitter is above the first receiver, and applying a predetermined adjustment to the electric field data from second receiver.

10. A method of analysing results from an electromagnetic survey according to any of claims 1 to 5, wherein the vertical gradient in the electric field data is determined by comparing electric field data detected from a transmitter at different heights.

11. A method of analysing results from an electromagnetic survey according to any of claims 1 to 10, further comprising:

providing background data specific to the area being surveyed; and

comparing the combined response data with the background data to obtain difference data sensitive to the presence of a subterranean resistive or conductive body.

12. A method of analysing results from an electromagnetic survey according to claim 11, wherein the background data are obtained by determining a vertical gradient in the magnetic field data and combining the vertical gradient in the magnetic field data with the electric field data.

13. A method of analysing results from an electromagnetic survey according to claim 12, wherein the vertical gradient in the magnetic field data is determined by comparing magnetic field data detected at different heights.

14. A method of analysing results from an electromagnetic survey according to claim 12, wherein the vertical gradient in the magnetic field data is determined by comparing the magnetic field data and data simulated using a background model.

15. A method of analysing results from an electromagnetic survey according to claim 14, wherein the data simulated using a background model provide a boundary condition for the magnetic field data.

16. A method of analysing results from an electromagnetic survey according to claims 12, wherein the vertical gradient in the magnetic field data at a first receiver is determined by comparing magnetic field data from the first receiver when the transmitter is above a second receiver with magnetic field data from the second receiver when the transmitter is above the first receiver, and applying a predetermined adjustment to the magnetic field data from second receiver.

17. A method of analysing results from an electromagnetic survey according to claims 12, wherein the vertical gradient in the magnetic field data is determined by comparing magnetic field data detected from a transmitter at different heights.

18. A method of analysing results from an electromagnetic survey according to claim 11, wherein the background data are obtained from a controlled source electromagnetic survey.

19. A method of analysing results from an electromagnetic survey according to claim 11, wherein the background data are obtained from a magneto-telluric electromagnetic survey.

20. A method of analysing results from an electromagnetic survey according to claim 11, wherein the background data are further combined response data obtained from another electromagnetic survey of the area performed at a different time.

21. A method of analysing results from an electromagnetic survey according to claim 11, wherein the background data are calculated from a rock formation model.

22. A method of analysing results from an electromagnetic survey according to claim 21, wherein the rock formation model is derived from a combination of geological data and resistivity data.

23. A method of analysing results from an electromagnetic survey according to claim 22, wherein the geological data are from seismological surveying.

24. A method of analysing results from an electromagnetic survey according to claim 22 or 23, wherein the resistivity data are from well logging.

25. A method of analysing results from an electromagnetic survey according to any of claims 1 to 24, wherein difference data are obtained as a function of position within the area.

26. A method of analysing results from an electromagnetic survey according to any of claims 1 to 25, wherein the resistive or conductive body is a resistive body.

27. A method of analysing results from an electromagnetic survey according to claim 26, wherein the resistive body is a hydrocarbon reservoir.

28. A computer program product bearing machine readable instructions for implementing a method of analysing results from an electromagnetic survey according to any of claims 1 to 27.

29. A computer apparatus loaded with machine readable instructions for implementing the method of analysing results from an electromagnetic survey according to any of claims 1 to 27.

30. A method of planning an electromagnetic survey of an area that is thought or known to contain a subterranean resistive or conductive body, comprising:

creating a model of the area to be surveyed including a rock formation containing a postulated resistive or conductive body, and a body of water above the rock formation;

setting values for water depth, depth of the postulated resistive or conductive body, and resistivity structure of the rock formation; and

performing a simulation of an electromagnetic survey in the model of the survey area by calculating electric field data and magnetic field data obtained by at least one simulated receiver detecting signals from at least one simulated horizontal electric dipole (HED) transmitter;

determining a vertical gradient in the electric field data; and

combining the vertical gradient in the electric field data with the magnetic field data to generate combined response data.

31. A method of planning an electromagnetic survey according to claim 30, further comprising:

adjusting the model to remove the postulated resistive or conductive body; and

repeating the simulation to obtain background data for comparison with the combined response data.

32. A method of planning an electromagnetic survey according to claim 30 or claim 31, the method further comprising:

repeating the simulation for a number of transmitter-receiver horizontal separations and frequencies of transmitter signal in order to select optimum surveying conditions in terms of transmitter-receiver horizontal separations and frequencies for probing the resistive or conductive body.

33. A method of planning an electromagnetic survey according to any of claims 30 to 32, wherein the resistive or conductive body is a resistive body.

34. A method of planning an electromagnetic survey according to claim 33, wherein the resistive body is a hydrocarbon reservoir.

35. A computer program product bearing machine readable instructions for implementing the method of planning an electromagnetic survey according to any of claims 30 to 34.

36. A computer apparatus loaded with machine readable instructions for implementing the method of planning an electromagnetic survey according to any of claims 30 to 34.

37. An electromagnetic survey method applied to a survey area that is thought or known to contain a subterranean resistive or conductive body, the survey area comprising subterranean strata beneath a seafloor, the method comprising:

providing at least one transmitter and at least one detector for transmission and detection of electromagnetic signals; and

obtaining data with transmission and/or detection at a plurality of different heights above the seafloor over the survey area, so that the data allow comparison of electromagnetic signals transmitted and/or received at different vertical displacements.

38. An electromagnetic survey method according to claim 37, wherein the transmission and/or detection at a plurality of different heights comprises detection at a plurality of different heights.

39. An electromagnetic survey method according to claim 38, wherein the detection at a plurality of different heights is made simultaneously by a corresponding plurality of detectors.

40. An electromagnetic survey method according to claim 37, wherein the transmission and/or detection at a plurality of different heights comprises transmission at a plurality of different heights.

41. An electromagnetic survey method according to claim 40, wherein the transmission at a plurality of different heights is made simultaneously by a corresponding plurality of transmitters.

42. An electromagnetic survey method according to claim 40, wherein the transmission at a plurality of different heights is made at different times by a single transmitter.

43. An electromagnetic survey method according to any of claims 37 to 42, wherein data are obtained as function of position over the survey area.

44. An electromagnetic survey method according to any of claims 37 to 43, wherein the resistive or conductive body is a resistive body.

45. An electromagnetic survey method according to claim 44, wherein the resistive body is a hydrocarbon reservoir.

46. An electromagnetic receiver for use in an electromagnetic survey of an area that is thought or known to contain a subterranean resistive or conductive body, the area comprising subterranean strata beneath a seafloor, the receiver, when normally deployed, being operable to measure electric fields at two or more different heights above the seafloor such that a vertical gradient in electric field may subsequently be determined.

47. An electromagnetic receiver according to claim 46, wherein the receiver is further operable to measure magnetic fields at two or more different heights such that a vertical gradient in magnetic field may subsequently be determined.

48. An electromagnetic receiver according to claim 46 or 47, wherein the receiver, when normally deployed, comprises first and second pairs of horizontally aligned electric dipole detectors extending in different horizontal directions, the pairs being positioned at different heights.

49. An electromagnetic receiver according to claim 47 or 48, wherein the receiver, when normally deployed, comprises first and second pairs of magnetic field detectors for detecting magnetic fields in different horizontal directions, the pairs being positioned at different heights.

50. An electromagnetic source for use in an electromagnetic survey of an area that is thought or known to contain a subterranean resistive or conductive body, the area comprising subterranean strata beneath a seafloor, the source comprising first and second transmitters which in normal use are disposed at different heights above the seafloor.